Active Project (2016 - 2018)

# Efficient, High Power Density Hydrocarbon-Fueled Solid Oxide Stack System, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

## ABSTRACT

Precision Combustion, Inc. (PCI) proposes to develop and demonstrate an innovative high power density design for direct internal reforming of regolith off-gases (e.g., methane and high hydrocarbons) within a solid oxide stack. The resulting breakthrough design offers the potential for higher overall efficiency, simplifies the system, and enables further compactness and weight reduction of the fuel cell system while significantly improving SOFC stack efficiency and the conditions for long system life. The approach also offers the potential to operate with a wide range of input fuels (i.e., high hydrocarbons as well as various levels of CO2 and water) without forming carbon. In Phase I all objectives and proposed tasks were successfully completed to demonstrate internal reforming concept for a high-power density, CH4-fueled solid oxide stack system. In Phase II, we will build on Phase I success to develop, fabricate, and demonstrate a TRL-4, breadboard solid oxide stack system operating with CH4. PCI's integrated reformer/fuel cell system will be much smaller, lighter, more thermally effective and efficient, and less expensive than current technology or prospective alternative structured catalytic reactor technologies. This effort would be valuable to NASA as it would significantly reduce the known spacecraft technical risks and increase mission capability/durability/efficiency while at the same time increasing the TRL of the solid oxide systems for ISRU application.

## ANTICIPATED BENEFITS

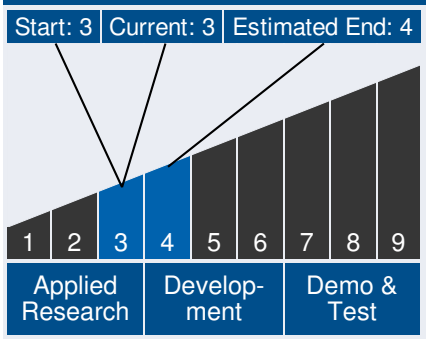
### To NASA funded missions:

Potential NASA Commercial Applications: NASA's requirement for the solid oxide fuel cell and electrolyzer module is a long term one, and will be mission critical for space exploration, NASA ISRU missions, and extending human presence across the solar system with its Morpheus Project. PCI's integrated reformer/fuel cell system will be much smaller, lighter, more


### Table of Contents



### Technology Maturity




### Management Team

**Program Executives:**

- Joseph Grant
- Laguduva Kubendran

**Program Manager:**

- Carlos Torrez

*Continued on following page.*

# Efficient, High Power Density Hydrocarbon-Fueled Solid Oxide Stack System, Phase II Project

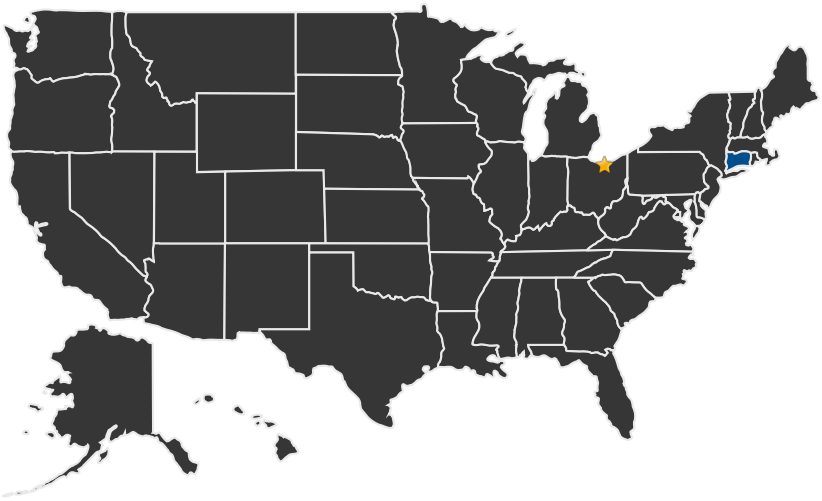


thermally effective and efficient, durable, and will offer advantages in terms of reduced launch mass/cost and reduced requirement for supplemental material re-supply.

**To the commercial space industry:**

Potential Non-NASA Commercial Applications: Targeted non-NASA applications include solid oxide fuel cell based application in the aerospace and distributed power generation industry. The implementation of PCI's internal reformer technology will lead to significant cost reduction by eliminating external reformer and heat exchanger in the SOFC system, plus a considerable gain in stack efficiency will significantly make the life cycle cost of owning SOFC system more economically favorable and competitive with respect to other distributed power generation systems (both conventional and renewable).

## U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

**Lead Center:**
Glenn Research Center

**Other Organizations Performing Work:**

- Precision Combustion, Inc. (North Haven, CT)

## Management Team *(cont.)*

**Principal Investigator:**

- Christian Junaedi

## Technology Areas

**Primary Technology Area:**
Space Power and Energy Storage (TA 3)
└ Power Generation (TA 3.1)
└ Chemical (TA 3.1.2)

# Efficient, High Power Density Hydrocarbon-Fueled Solid Oxide Stack System, Phase II Project

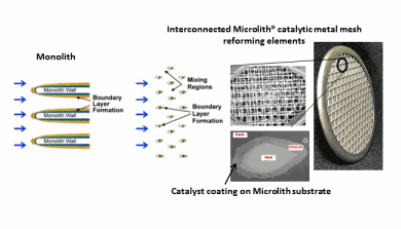


## PROJECT LIBRARY

### Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23212)

## IMAGE GALLERY




*Efficient, High Power Density Hydrocarbon-Fueled Solid Oxide Stack System, Phase II*

## DETAILS FOR TECHNOLOGY 1

### Technology Title

Efficient, High Power Density Hydrocarbon-Fueled Solid Oxide Stack System, Phase II

### Potential Applications

NASA's requirement for the solid oxide fuel cell and electrolyzer module is a long term one, and will be mission critical for space exploration, NASA ISRU missions, and extending human presence across the solar system with its Morpheus Project. PCI's integrated reformer/fuel cell system will be much smaller, lighter, more thermally effective and efficient, durable, and will offer advantages in terms of reduced launch mass/cost and reduced requirement for supplemental material re-supply.